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## (54) Door Locking Device

(57) A door locking device for locking the door of a washing machine for the duration of its operating cycle comprises a heating plate (15) having a positive temperature coefficient, first and second bimetal members (17, 25) arranged to be heated and thus

deformed by the plate and a pivotally mounted contact arm (18) having both an electrical contact (19) and a latch pin (21) at its free end and being elastically connected to the first bimetal member 17 in such a way as to be actuated in one direction when said first bimetal member 17 reaches a preset heating temperature and in the other direction on cooling and said second bimetal member 25 being deformed when a given ambient temperature is exceeded and acting against said contact arm 18 to actuate said contact arm when said first bimetal member 17 is no longer heated.

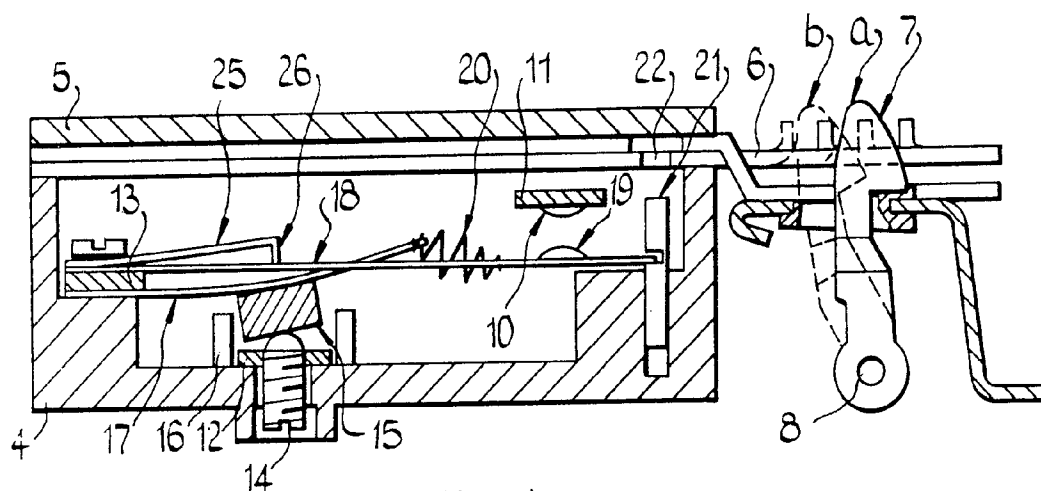


Fig. 1

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## SPECIFICATION

### Door Locking Device

The invention relates to a device, in particular for a domestic clothes washing machine and the like, which is capable of providing for locking of the door fastener as long as the machine is in operation and the drum of the machine is in movement, and for unlocking the door fastener when the machine has been disconnected from the electrical supply mains and the drum of the machine has stopped.

Various kinds of door locking devices are known, which substantially achieve the above-stated function, and which comprise suitable electrical, electromechanical, pneumatic and like devices. In particular, German Patent Application No. 2,708,086 discloses a door locking device comprising a small plate based on a material having a positive temperature coefficient (PTC), which is disposed between two bimetal members such that the movements produced by their thermal deformation are added together and actuate a movable contact arm capable of occupying limit positions, the said plate member being mounted for oscillating movement between said bimetal members and being capable of maintaining thermal and electrical contact, and said bimetal members being capable of passing electrical current to the terminals of said plate.

The above-mentioned movable contact arm is provided with an electrical contact which co-operates with a similar fixed electrical contact connected to the electrical circuit of the machine, and with a pin co-operating with a hole drilled in the door bolt for closing the door.

Consequently, when the machine is arranged for operation and the door is closed, voltage is applied to the base plate which rises in temperature rapidly (within the time of the order of magnitude of from 2 to 5 seconds), whereby the bimetal members in contact with the plate are rapidly heated, and expansion thereof causes movement of the movable contact arm.

The above-mentioned pin is then inserted into the hole in the door bolt, thus locking the door of the machine.

This locking device is found to be advantageous in comparison with the previous devices, by virtue of the fact of its operating with very short intervention times in respect of the above-described bimetal members.

According to the present invention, there is provided a door locking device comprising at least one heating plate based on a material with a positive temperature coefficient, first and second bimetal members co-operating with said plate in such a way as to be heated thereby and thus to be deformed, and a movable contact arm pivotally mounted at a first one of its ends and provided at its other end with an electrical contact capable of co-operating with a further fixed electrical contact connected to the electrical circuits of the machine, and with a pin capable of engaging into

a hole in the door closure bolt when the bolt is in the position of locking the door, wherein the heating plate is supported by guide means in such a way as to be electrically connected between said first bimetal member and a terminal of the electrical supply mains, said first bimetal member has a free end which is mechanically connected to said contact arm by way of an elastic means in such a way as to actuate the contact arm in one direction when said first bimetal member is deformed in accordance with a preset heating temperature and in the other direction when said first bimetal member is no longer heated and, cooling down again, returns to its initial position, and has a fixed end connected to the other terminal of the electrical supply mains together with said first end of the contact arm and a fixed end of said second bimetal member, and said second bimetal member is deformed when a given ambient temperature is exceeded and acts against said contact arm by means of the other of its ends, thereby to actuate said contact arm when said first bimetal member is no longer heated.

The features of the invention will be more clearly apparent from the following description by way of non-limiting example and with reference to the accompanying drawings in which:

Figure 1 shows a view in longitudinal section of an embodiment of locking device according to the invention, in the rest condition;

Figure 2 shows the device of Figure 1 in the operating position, and

Figure 3 shows a perspective view of part of the locking device of Figure 1.

Referring to the drawings, the locking device according to the invention comprises a housing 4 of electrically insulating material, which is closed upwardly by a cover 5; a slidable member 6 forming the door bolt for opening and closing the door of a domestic clothes washing machine; a catch member 7 pivoted at point 8 to the casing (not shown) of the machine and capable of being engaged in *per se* known manner in an opening 9 provided in the slide member 6 (position 'a' of the catch member 7) and thereby preventing opening of the door, said catch member being capable of disengagement from the above-mentioned opening 9 and thereby permitting the door to be opened (this is the position shown in broken lines at 'b' of the catch member); an electrical contact 10 connected to a terminal 11 which is in turn connected to the electrical supply circuits of the machine; a terminal 12 connected to a conductor of the electrical supply network of the machine; a terminal 13 connected to the other conductor of the electrical supply network of the machine; a regulating screw 14 with a rounded head which is screwed into the terminal 12; a heating plate 15 based on material with a positive temperature coefficient (PTC), which is contained within suitable guide support members 16 fixed to the housing 4 in such a way that it can be displaced within said support members to a limited extent

(Figure 1 shows how the heating plate is displaced, to a greater extent than the displacement which actually occurs); a first bimetal member 17 which is fixed by one end to the terminal 13 and preloaded so as to ensure that the plate applies a continuous thrust force against the regulating screw and which is capable of being rapidly deformed in dependence on the temperature attained by the heating plate 15; the arrangement of these components is such that, by acting on the regulating screw 14, the plate 15 is pressed more or less strongly against the first bimetal member 17 thereby varying the time required for the latter to be deformed; a movable contact arm 18 of metal material, which is fixed by one end to the terminal 13 and which is provided with an electrical contact 19 capable of co-operating with the above-mentioned electrical contact 10; a spring 20 which is mechanically connected between the contact arm 18 and the free end of the first bimetal member 17; and a pin 21 which is disposed in association with the other end of the contact arm 18 and which is capable of engaging into a hole 22 drilled in the door bolt 6 when the latter is in the position of closing the door. The contact arm 18 is in the form of a blade having two side limb portions 23 and a central opening 24 within which said first bimetal member 17 can be displaced (see Figure 3). The present locking device further comprises a second bimetal member 25 which is disposed above the contact arm 18 and which is fixed by one end to the terminal 13. The second bimetal member is capable of being deformed in dependence either on the temperature attained by the plate 15 or the ambient temperature. The other bent end of the second bimetal member 25 faces downwardly (portion 26) in such a way that it can act against the contact arm, as will be described hereinafter.

The mode of operation of the locking device is as follows:

Initially, when the machine is not operating, the above-described locking device is in the rest condition shown in Figure 1.

As soon as the machine has been set up for operation and the door of the machine is closed (catch member 7 in position 'a' and the hole 22 in the slide member 6 aligned with the pin 21), the general on-off switch of the machine is operated and voltage is thus applied to the plate 15.

Rapid heating therefore occurs, either of the plate 15 or of the first bimetal member 17 which is in contact therewith, with consequent progressive deformation of the bimetal member 17 and a downward pull on the spring 20 which is compressed against the contact arm 18.

As soon as a preset temperature is exceeded, the spring 20 moves downwardly by the action of the first bimetal member 17 (position in Figure 2) and jumps the movable contact arm 18 upwardly whereby the contacts 10 and 19 close and voltage is applied to the electrical components of the machine in accordance with the sequences controlled by the programmer, whereby the machine performs its operating cycles.

It should be noted that the rounded head of the regulating screw 14 permits the heating element 15 to move with an oscillating motion with respect to the head of the screw 14 thereby always to assume the most suitable position for maintaining the best contact with the first bimetal member 17.

When the operating cycles are concluded, the programmer disconnects the machine from the electrical mains whereby the heating plate 15 begins to cool down. Consequently, the first bimetal member 17 gradually returns to the initial position.

However, because the bimetal member has long remained in the operating position and thus the high ambient temperature to which it has been subjected has produced greater deformation thereof, in consequence, in order to be able to return to the initial position within the period of time provided by the international standards, it is necessary for the second bimetal member 25 which is provided for the purpose, to come into action.

Indeed, the second bimetal member 25 is deformed at ambient temperature and consequently its curved end 26 pushes the contact arm 18 downwardly until, by virtue of the combined action of the bimetal member 17 and the spring 20, the contact arm returns to the initial rest position of Figure 1 in which the contacts 10 and 19 are separated and the pin 21 is disengaged from the hole 22 in the slide member 6, whereby the door of the machine can be opened.

To achieve this, the second bimetal member 25 is so constructed as to ensure, together with the first bimetal member 17, that the contact arm 18 is actuated within the short period of time set down by international standards.

The locking device above described is of small dimensions and accordingly compact. Such a device is also provided with a mechanism for actuating the contact arm, which has a small number of components but which is such as to actuate the arm with actuating times of the order of 2/10 seconds, and to guarantee that the guiding directions are observed and to ensure maximum functional reliability.

#### Claims

1. A door locking device comprising at least one heating plate based on a material with a positive temperature coefficient, first and second bimetal members co-operating with said plate in such a way as to be heated thereby and thus to be deformed, and a movable contact arm pivotally mounted at a first one of its ends and provided at its other end with an electrical contact capable of co-operating with a further fixed electrical contact connected to the electrical circuits of the machine, and with a pin capable of engaging into a hole in the door closure bolt when the bolt is in the position of locking the door, wherein the heating plate is supported by guide means in such

- a way as to be electrically connected between said first bimetal member and a terminal of the electrical supply mains, said first bimetal member has a free end which is mechanically connected to
- 5 said contact arm by way of an elastic means in such a way as to actuate the contact arm in one direction when said first bimetal member is deformed in accordance with a preset heating temperature and in the other direction when said
- 10 first bimetal member is no longer heated and, cooling down again, returns to its initial position and has a fixed end connected to the other terminal of the electrical supply mains together with said first end of the contact arm and a fixed
- 15 end of said second bimetal member, and said second bimetal member is deformed when a given ambient temperature is exceeded and acts against said contact arm by means of the other of its ends, thereby to actuate said contact arm
- 20 when said first bimetal member is no longer heated.
2. A locking device according to claim 1 wherein said plate is pressed against said first bimetal member by a regulating screw which has
- 25 a rounded head and which is screwed into said terminal.
3. A locking device according to claim 1 or 2 wherein said movable contact arm is in the form of a blade having two side limb portions and a central opening within which said first bimetal member can move.
- 30 4. A locking device for a door, constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.
- 35 5. A domestic clothes washing machine incorporating a device according to any one of the preceding claims.